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Daily self-nudging towards physical activity: implications for vigour, creativity, and prosocial work behavior

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ABSTRACT

This study integrates nudging and proactivity theories to investigate how individuals can nudge themselves to be more physically active. We test the daily effects of self-nudging on vigour and use the dual pathway to creativity model to predict indirect effects on two non-targeted outcomes: creativity and prosocial behaviour. One hundred eighty-two ($N_{L2} = 182$) employees filled out a short survey for five consecutive days ($N_{L1} = 672$). Results of multilevel structural equation modelling provide evidence for the hypothesized model. Daily self-nudging towards physical activity was positively related to (a) creativity and (b) prosocial behaviour through vigour (a combination of physical strength and cognitive liveliness) – after controlling for previous-day levels of the mediator and outcomes. Self-nudging also showed direct effects on the two non-targeted outcomes. These findings offer support for nudging theory and the dual pathway to creativity model. We discuss the theoretical implications and three practical applications.

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nudging theory; physical activity; prosocial behaviour; self-nudging; vigor

Since the Industrial Revolution, work has steadily changed from predominantly physical tasks to those requiring mental engagement. As a result, many employees now find themselves in an office environment, working primarily with their minds rather than their hands. This shift has significantly increased sedentary behaviour, with employees spending most of their workdays seated (Gardner et al., 2016). The cognitive demands of their jobs can be draining (Mazzola & Disselhorst, 2019), often leaving them with insufficient energy or motivation to engage in physical activity. This phenomenon is known as the "recovery paradox" (Sonnentag, 2018, p. 170) – increased job demands lead to decreased recovery activities such as physical exercise. Despite these challenges, physical activity remains vital for maintaining health and well-being. Regular physical activity has numerous benefits, including weight management, improved cardiovascular health, enhanced cognition, and overall subjective well-being (e.g., Buecker et al., 2021; Daskalopoulou et al., 2017). Unfortunately, traditional interventions aimed at increasing physical activity among office workers have shown limited effectiveness (e.g., Chu et al., 2016; Conn et al., 2011; Freak-Poli et al., 2020; Lusa et al., 2020), highlighting the urgent need for innovative approaches.

The present study investigates the potential of daily *self-nudging* in regulating individuals' physical activity levels. Self-nudging involves the application of behavioural strategies designed to motivate oneself towards increased physical activity. This concept draws inspiration from the principles of social nudging, a behavioural economics theory (Thaler & Sunstein, 2008). The foundation of nudge theory rests on the understanding that human decision-making often relies more on intuitive processes than thoughtful deliberation (Kahneman, 2017). The core idea is that subtle modifications of the environment (i.e., the "choice architecture") can guide individuals towards better decisions and desired outcomes without restricting options or significantly altering economic incentives. Self-nudging furthers this concept by empowering individuals to create their own choice architecture. In the context of physical activity, self-nudging strategies might include setting up activity reminders, creating visual cues for exercise, or modifying one's environment to make physical activity more accessible and appealing.

Our study utilizes a daily diary methodology to examine how self-nudging techniques increase vigour and, subsequently, influence key work outcomes, particularly creativity and prosocial behaviours. This approach

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provides a nuanced understanding of how small, self-directed strategies can significantly enhance individual well-being and workplace performance. By tracking these variables day-by-day, we aim to uncover the dynamic interplay between self-nudging, energy levels, and positive work-related behaviours, offering valuable insights for both employees and organizations.

We seek to make three contributions to existing literature. First, our study aims to expand the current understanding of self-nudging by providing empirical evidence of its effectiveness in promoting vigour. While previous research has explored self-nudging in specific contexts like fruit consumption (e.g., van Rookhuijzen et al., 2023) and smartphone use (Grüning et al., 2023), our study extends its application to physical activity. Utilizing a field study with a daily diary design, we capture the immediate effects of self-nudging on vigour while preserving essential contextual factors often lost in laboratory settings, thereby addressing a significant gap in nudging research (Beshears & Kosowsky, 2020).

Second, we examine the broader implications of increased vigour for work-related outcomes, offering insights into how self-nudging can enhance both individual well-being and important *non-targeted* outcomes. We integrate nudging theory with the dual pathway to creativity model (Nijstad et al., 2010) and propose that self-nudging promotes physical strength and cognitive flexibility – key components of vigour (Shirom, 2010). The increased vigour, in turn, is hypothesized to promote creativity. This hypothesis builds on the well-established benefits of physical activity for cognitive function – including executive control, attention, and memory processes (Roig et al., 2013; Verburgh et al., 2014). Such improvements directly contribute to increased cognitive flexibility, a crucial element in creative thinking.

In addition to daily creativity, we explore daily prosocial behaviour as another potential outcome of self-nudging, which serves as a third contribution of our study. We argue that increased physical energy levels resulting from self-nudging for physical activity make employees more willing to engage in helping behaviours, while enhanced cognitive liveliness may facilitate better perspective-taking and empathy. Our focus on the non-targeted outcomes of self-nudging answers recent calls for research on unintended consequences (Beshears & Kosowsky, 2020). While these authors suggest that unintended consequences may partly diminish, eliminate, or even reverse the benefits of nudges on a targeted dimension, we propose that self-nudging can lead to unintended *favorable* work outcomes. Through this study, we offer practical solutions for integrating physical activity into individuals' daily routines, ultimately fostering healthier and more productive work environments. By demonstrating the indirect benefits of self-nudging for creativity and prosocial behaviour, we provide a compelling case for organizations to support and encourage such practices among their employees.

Theoretical background

Health behaviour change policies and interventions have traditionally relied on conscious and reflective processes, such as offering information, altering how individuals think about their actions, or introducing financial and legal incentives to modify behaviour (Cecchini et al., 2010). However, these methods have only shown moderate success (Rongen et al., 2013; Vlaev et al., 2016). A potential explanation for this limited effectiveness is that human behaviour is also shaped by automatic and unconscious processes, which have largely been overlooked in the health behaviour change literature. Nudge theory (Thaler & Sunstein, 2008) suggests that people frequently rely on mental shortcuts, or heuristics, to simplify decision-making. As a result, their choices are heavily influenced by the context in which decisions are made (Vlaev et al., 2016). Heuristics simplify choices but can also make people susceptible to cognitive tendencies, which in turn heavily influence their actions. For example, people may exhibit preferences for default options, respond disproportionately to how information is framed, or underestimate the impact of delayed consequences. By understanding cognitive tendencies and intuitive decision-making, we can structure people's environments to encourage healthier behaviours (Thaler & Sunstein, 2008; Volpp et al., 2008).

Central to nudge theory is the concept of choice architecture, which involves intentionally designing the environments in which decisions are made to guide individuals towards more desirable outcomes. This may involve minor adjustments to how options are presented, or how decisions are structured, to strategically utilize common cognitive tendencies. For instance, placing healthier food options at eye level in a cafeteria encourages healthier eating choices without restricting freedom of choice (Bucher et al., 2016). Similarly, automatic enrolment in retirement savings plans takes advantage of the default effect, where individuals are more likely to stick with pre-selected options (Camilleri et al., 2019). By understanding the interplay between cognitive tendencies, environmental context, and intuitive decision-making, nudge theory allows practitioners to design strategies that align with natural human tendencies. This approach has been effectively applied in various domains, including public health, where subtle

environmental changes have promoted behaviours such as increased physical activity (Forberger et al., 2016), improved dietary habits (Verplanken & Wood, 2006), and medication adherence (Volpp et al., 2008; for a meta-analysis, see; Mertens et al., 2022).

Forberger et al. (2022) examined 26 interventions designed to promote physical activity or reduce sedentary behaviour in workplace environments using nudging strategies. A common strategy in these interventions was subtle visual cues encouraging stair use over elevators. For instance, arrows placed on floors to direct employees towards staircases; or stairways designed to resemble a piano – where each step emitted a musical note – making stair climbing an engaging experience. Despite such innovative efforts, only 54% of the interventions produced notable effects, such as increased stair use, enhanced walking activity, and reduced sitting time. The limited effectiveness of these nudges can be attributed to several factors. One significant issue is the perceived loss of autonomy, as some employees may experience nudges as paternalistic, raising questions like, "Why are others trying to control my choices?" This sense of restricted freedom can lead to psychological reactance, where individuals resist or reject the suggested behaviours (Brehm & Brehm, 2013). Furthermore, social nudges may face challenges in catering to a broad population's diverse needs and preferences, bearing the difficulty of designing universally effective cues. These limitations highlight the complexity of influencing behaviour on a large scale (De Ridder et al., 2024; Dewies et al., 2021).

Self-nudging

Self-nudging is an emerging concept that extends traditional nudging principles, empowering individuals to design their own environments in ways that promote desired behaviours. Unlike external nudges implemented by policymakers or organizations, self-nudging encourages personal agency and self-regulation (Reijula & Hertwig, 2022). The idea behind self-nudging is that individuals can apply the same principles used in traditional nudges – such as altering the choice architecture or leveraging cognitive tendencies – to influence their own behaviour. For example, individuals may set up reminders for regular exercise on their phone or place healthy snacks at eye level in their pantry. By consciously structuring their environment, people can create conditions that make it easier to achieve personal goals.

Self-nudging encourages individuals to consciously modify their surroundings to increase the likelihood of adopting positive habits. By blending slow, deliberate thinking processes (System 2) with faster, more intuitive responses (System 1), self-nudging may offer a powerful tool for guiding behaviour effectively (Kahneman, 2017). According to Tontrup and Sprigman (2022), those who practice self-nudging must first acknowledge their present cognitive tendencies and the cognitive shortcuts they want to address. They must also anticipate how modifying their decision-making environment can strategically harness these heuristics to their advantage. For instance, using System 2 processes, employees may download a fitness-tracking app that monitors activity and sets challenges. Additionally, by leveraging System 1 thinking, they can create daily cues that encourage physical activity with minimal conscious effort. For example, they might share their workout progress with friends on social media to foster accountability, or place dumbbells in a visible area of their workspace to act as subtle, automatic reminders to exercise (To & Bakker, 2018).

Self-nudging is conceptually distinct from traditional behaviour change strategies such as goal-setting, habit formation, or implementation intentions. While techniques like goal-setting (Locke & Latham, 2002) and implementation intentions (Gollwitzer, 1999) operate primarily through internal cognitive regulation, self-nudging involves individuals actively modifying their external environment to make desired behaviours more likely (Reijula & Hertwig, 2022). This approach allows people to become the "choice architects" of their own lives by using subtle environmental cues – for example, placing running shoes by the bed or turning on smartphone notifications – to support their goals. Unlike habit formation, which depends on the gradual automatization of behaviour through repetition and reinforcement (Lally & Gardner, 2013), self-nudging integrates deliberate intention with the strategic use of environmental cues – engaging both conscious and automatic processes to enable flexible, context-sensitive behaviour change (Thaler & Sunstein, 2008). Self-nudging operates at the intersection of automatic (System 1) and deliberative (System 2) processes, enabling individuals to strategically shape their own default behaviours (Sunstein, 2016). In doing so, self-nudging offers a meta-cognitive and autonomy-enhancing route to sustained behavioural activation, distinguishing it theoretically and practically from more established techniques (Münscher et al., 2016).

Self-nudging toward physical activity and vigor

Shirom and Leiter (2010) conceptualized vigour as activated positive affect, including three dimensions: physical strength, emotional energy, and cognitive liveliness. In the present study, we focus on physical strength and

cognitive liveliness as key dimensions because they are most relevant to and likely influenced by physical activity (see also, Klijn et al., 2021). Physical strength is defined as a robust *physical* capacity that enables individuals to engage in tasks energetically. In contrast, cognitive liveliness refers to *mental* alertness, encompassing the capacity to think clearly, focus, and engage in cognitive tasks with energy and enthusiasm (Shirom, 2003). Thus, we concentrate on key components of vigour, which refer to physical energy and mental agility at work that could be generated by proactive behaviours (Shirom, 2010).

We propose that self-nudging towards physical activity is positively related to vigour, particularly in terms of physical strength and cognitive liveliness. By automating the decision-making process, self-nudging encourages consistent physical activity (cf. Reijula & Hertwig, 2022), such as walking, exercising, or stair climbing, without excessive mental effort. Unlike external nudges, self-nudging offers a personalized approach, making it more effective in motivating individuals to engage in regular movement that aligns with their preferences. This process will likely enhance physical fitness, improving the ability to perform daily tasks with energy while maintaining enough stamina to enjoy leisure activities and handle unexpected challenges (Caspersen et al., 1985). By continuously engaging in physical activity through self-nudges, individuals can incrementally enhance their cardiorespiratory endurance, muscular strength, and flexibility (e.g., Bahls et al., 2021; Leblanc et al., 2015). Additionally, as physical activity improves, cognitive liveliness is likely to benefit, with enhanced mental sharpness and focus resulting from the regular energy boosts provided by daily exercise (Puetz, 2006).

Moreover, although we focus on *self-nudging toward physical activity* – rather than measuring physical activity directly – there is strong empirical support for the assumption that even small, daily changes in physical activity behaviour have robust effects on vigour and cognitive vitality (Prakash et al., 2015; Puetz, 2006). Self-nudging empowers individuals to deliberately shape their environment and habits to support goal-directed behaviour, thereby enhancing autonomy and sustainable behavioural activation (Sunstein, 2016; Tontrup & Sprigman, 2022). Given that physical activity is one of the most reliable behavioural predictors of energy and cognitive clarity (Erickson et al., 2019; Puetz, 2006), even low-threshold self-initiated strategies (i.e., nudges) aimed at increasing such activity are theoretically and empirically likely to improve both physical and psychological vigour.

Hypothesis 1: Daily self-nudging towards physical activity positively relates to daily vigour.

Self-nudging toward physical activity and work outcomes

In addition to the direct effect of self-nudging towards physical activity on vigour, we propose that vigour mediates the relationship between self-nudging and creativity. Creativity refers to idea generation, insights, or problem solutions that are both novel and potentially useful (Amabile, 1997; Anderson et al., 2004). Research suggests that self-nudging towards physical activity could be indirectly related to creativity due to the well-established benefits of physical activity on brain function (Erickson et al., 2019). Physical exercise is known to increase cerebral blood flow and promote the release of neurotrophic factors, such as brain-derived neurotrophic factor (BDNF), which supports neuroplasticity and cognitive function (Hötting & Röder, 2013). Furthermore, physical activity enhances energy metabolism, providing the brain with more efficient energy resources to improve cognitive processes. Exercise is also linked to stress reduction and mood improvement (Mikkelsen et al., 2017), which may result in better focus and persistence when working on complex tasks (Diener et al., 2020; Tsai et al., 2007). However, since our focus is on *self-nudging toward physical activity* rather than physical activity itself, we refrain from proposing a direct effect hypothesis regarding creativity.

The dual pathway to creativity model (De Dreu et al., 2008; Nijstad et al., 2010) proposes that creativity depends on cognitive flexibility and persistence. Accordingly, creative solutions can only emerge from loosely connected ideas and impressions when individuals possess enough psychological resources to flexibly shift between options and persist until a solution is reached. Research consistently supports the idea that cognitive and energetic resources play a crucial role in fostering creativity (Baas et al., 2008; Hennessey & Amabile, 2010; Ning et al., 2015). For example, Op den Kamp et al. (2018); Study 1) showed that employees with higher scores on cognitive liveliness showed improved creative work performance. In addition, they found in a follow-up study that on days employees felt more vigorous, they were better able to come up with novel ideas (Op den Kamp et al., 2018; Study 2). Similarly, De Vries et al. (2022) discovered that

employees who exercised during lunch breaks experienced a noticeable boost in momentary vigour – characterized by heightened cognitive liveliness and emotional energy – immediately afterwards. While the study did not confirm a mediation effect, vigour following the lunch break positively influenced creative work performance in the afternoon. Further supporting this, Ma et al. (2024) conducted a 10-day diary study with employees from creative industries (e.g., architecture design, filmmaking, fashion design, copywriting). They demonstrated that daily vitality, directly and indirectly, enhanced daily creativity through exploration and a strong focus on work activities (absorption).

Building on this literature, we propose that self-nudging towards physical activity enhances creativity by energizing both cognitive and motivational pathways. The cognitive liveliness component of vigour facilitates mental flexibility – enabling individuals to fluidly shift between categories, escape cognitive fixation, and generate diverse, original ideas through divergent thinking. Simultaneously, the physical strength component of vigour supports cognitive persistence, allowing deeper exploration and refinement of ideas. This dual activation maps directly onto the dual pathway to creativity model (De Dreu et al., 2008; Nijstad et al., 2010), which posits that creative performance arises through either flexibility or persistence – or an interplay of both. Therefore, on days when employees experience higher levels of vigour as a result of self-nudging, they are not only more cognitively agile but also more motivated to persist – creating ideal conditions for innovative problem-solving at work.

Hypothesis 2: Daily self-nudging towards physical activity positively relates to daily creativity through daily vigour (mediation effect).

We further argue that vigour mediates the relationship between self-nudging and altruistic or prosocial behaviour. Prosocial behaviour represents voluntary and intentional actions that benefit someone else (Eisenberg & Miller, 1987). This behaviour is motivated by a genuine concern for others, rather than the pursuit of external rewards or the avoidance of negative consequences. Research indicates that self-nudging towards physical activity may be indirectly related to prosocial behaviour. Daily exercise enhances personal and social competencies, including emotional regulation, communication skills, and empathy (e.g., Gil-Beltrán et al., 2020; Lubans et al., 2016). These daily improvements help individuals better understand and connect with others, fostering prosocial actions (Davis, 2015; Eisenberg et al., 2002). For instance, a brief daily workout can improve mood and emotional balance, enabling more effective and empathetic communication in personal and professional interactions. A study involving 20,000 Chinese students found that physically active students were more likely to engage in honest, friendly, and helpful behaviours towards others (Wan et al., 2021). This finding was supported by further research showing similar effects among employees, demonstrating consistent effects of physical activity in promoting prosocial behaviour (Duan et al., 2022).

Physical activity is also associated with better mental health and more optimal emotional states (Naczenski et al., 2017). This improved psychological well-being may make individuals more inclined to engage in prosocial and altruistic acts (Shirom, 2010). According to Fredrickson (2001), activated positive emotional states such as vigour can broaden people's thought-action repertoires. Thus, when individuals feel more vigorous due to daily self-nudging, they may be more inclined to exhibit prosocial behaviours at work. Spanouli and Hofmans (2021) confirmed this by showing that employees with higher levels of vigour were more likely to assist colleagues. Similarly, Little et al. (2011) found that vigorous employees actively reduce interpersonal distances to maintain their positive emotions, which contributes to increased prosocial behaviour, reinforcing the pivotal role of vigour in fostering prosocial tendencies.

Vigour plays a pivotal role in enabling prosocial behaviour because it provides the energetic and emotional resources necessary to move beyond self-focus and engage meaningfully with others. On days when employees experience elevated vigour – stimulated by self-nudging towards physical activity – they are more likely to demonstrate prosocial behaviours. Whereas fatigue and ego depletion are known to constrict attentional scope and diminish social sensitivity (Gamble et al., 2023; Xu et al., 2012), vigour supports a broadened interpersonal orientation by enhancing self-regulatory strength, emotional openness, and motivational readiness (Shirom, 2010; Spanouli & Hofmans, 2021). Crucially, vigour is not merely a fleeting affective state, but a renewable psychological resource that expands one's capacity for empathy, generosity, and interpersonal responsiveness – core drivers of altruistic and cooperative behaviour.

Hypothesis 3: Daily self-nudging towards physical activity positively relates to daily prosocial behaviour through daily vigour (mediation effect).

Method

Procedure

The data for this study was collected via short online surveys during five consecutive workdays. Employees from a variety of industries and companies in Romania were recruited using social media platforms (e.g., LinkedIn, Facebook) to promote the study. The research team created posters and social media posts and used snowball sampling to spread the subscription link. Undergraduate students in their last year of studies could receive bonus points on their research methods course if they successfully recruited and retained eligible participants for the study. Individuals were considered eligible if they were over 18 years old, had a job where they had worked for at least six months, and were active during the days of the study (i.e., they were not on vacation, sick leave, or away from work for any other reason).

As our study posed minimal risk to participants – with no influence or deception involved, no targeting of vulnerable individuals, and full informed consent obtained – the university's ethics committee determined that an ethical review was not technically required. To register for the study, participants had to fill in informed consent and a survey containing demographic information. In this survey, participants also indicated an email address and a participant code. The research team used these email addresses and codes to communicate the daily surveys to the participants. Each daily questionnaire was sent out after 2 p.m. and was open for responses until the end of the day. Participants received reminders throughout the day (at 4 p.m. and 6 p.m.) to minimize dropout rates. To incentivize participants and further prevent dropout, we organized a raffle (for 10 vouchers of approximately 40 euros) after the closing of the study. Those who responded to at least 4 daily surveys were eligible to participate in the raffle. In total, 206 employees filled out the initial questionnaire to register for the study, and 198 proceeded to participate in the daily phase responding to at least 1 daily survey. Given the study's focus on within-person effects and needs to account for lagged effects, for the final sample we retained only 182 participants who responded to at least 3 daily surveys (88% response).

Participants

A total of one-hundred and eighty-two ($N_{L2} = 182$) employees participated in the daily survey, responding to short questionnaires across 3–5 consecutive working days (3.69 days on average). This translates into a set of six-hundred and seventy-two ($N_{L1} = 672$) daily observations. Participants came from various industries, such as services (17%), automotive (10%), healthcare and pharma (3%), education (21%), IT and telecommunication (14%), and others (34%). Further, 71% worked in the private sector, with 29% being employed in the public sector. Participants (41% male) had a mean age of 33.4 years (SD = 11.01), with 11.5 years of tenure on average (SD = 9.9). Most respondents had completed a form of higher education (31% Bachelors' degree, 43% Masters' degree); 20% reported high-school education, while a smaller proportion had some kind of professional training (6%).

Participants worked from home (14%), from the office (50%), or in a hybrid arrangement (35%). They mostly had full-time employment (89%) in non-managerial positions (75%).

Measures

Daily self-nudging was measured using a 10-item scale developed by To and Bakker (2018). Participants rated their agreement to statements such as "Today, I made sure that I had fitness equipment in sight for a short exercise break," "Today, my smartphone reminded me of physical activity goals throughout the workday," and "Today, I used wearables (e.g., fitness tracker, smartwatch) to track my physical activity." Participants could respond to the items using a 7-point scale (1 = *Strongly disagree*, 7 = *Strongly agree*). The scale has been validated in a study among 1540 Japanese employees (Bakker et al., in press)). Factor analyses confirmed a reliable one-factor structure, and the scale demonstrated content and predictive validity, showing positive longitudinal relationships with, for example, physical activity and physical capacity (fitness, energy). Specifically, the latter study showed that self-nudging towards physically activity was positively related to *increases* in physical activity over three months of time. In the present study, the scale also showed high multilevel reliability (Geldhof et al., 2014), with within-person $\omega = .83$.

Daily vigor was measured using 10 items of the scale developed by Shirom (2003). The scale operationalizes vigour as a two-dimensional construct, including cognitive liveliness (e.g., "Today, I felt I could think rapidly"), and physical strength (e.g., "Today, I felt full of energy"). Responses were given on a scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*). The scale showed excellent reliability ($\omega_{L1} = .94$).

Daily creativity was assessed using a 4-item subscale from Miron et al. (2004) Cognitive Styles questionnaire. The items were adapted to capture daily experiences of creative expression (e.g., "Today, I had a lot of creative

ideas.") on a Likert scale from 1 (*Strongly disagree*) to 7 (*Strongly agree*). Responses on this scale also had high multilevel reliability ($\omega_{L1} = .89$).

Daily prosocial behavior was assessed using the 5 items of the Altruism subscale from Podsakoff et al. (1990) Organizational Citizenship Behavior Scale. The items captured daily altruistic behaviours towards colleagues (e.g., "Today, I was always ready to lend a helping hand to those around me"). Participants responded again using a scale ranging from 1 (*Strongly disagree*) to 7 (*Strongly agree*). This scale also demonstrated good reliability at the day level ($\omega_{L1} = .77$)

Analytical strategy

We tested our hypotheses through the means of multilevel structural equation modelling, following Preacher and colleagues' guidelines (MSEM; Preacher et al., 2010, 2011) in Mplus 8 (Muthén & Muthén, 1998–2017), using Maximum Likelihood estimation with Robust Standard Errors (MLR). We opted for MSEM due to its analytical advantages over traditional multilevel modelling techniques in terms of (1) the possibility to specify latent constructs, (2) the comprehensive assessment of model fit, (3) the possibility of estimating indirect effects, and (4) obtaining unconflated effects by using latent centring to extract within-person and between-person variance (Preacher et al., 2010, 2011). All variables were operationalized and specified at the within-person level, modelling both contemporaneous and lagged daily relationships.

To establish multilevel construct validity, we first conducted multilevel confirmatory factor analyses (MCFA). The hypothesized measurement model (M1) included six factors: self-nudging, indicated by 10 items, creativity indicated by 4 items, prosocial behaviour indicated by 5 items, and vigour being a second-order factor that is indicated by cognitive liveliness and physical strength as first-order factors (indicated by 5 items each). Since all daily measures were included in one questionnaire, it is important to ensure that the daily scores reflect separate constructs and are not overlapping due to common method bias (Podsakoff et al., 2012). Thus, we compared M1 to an alternative in which all items were specified to indicate one common method factor (M2). Additionally, we constructed a third measurement model (M3) to ensure that the vigour – creativity relationship specifically was not driven by overlapping conceptualization or measurement. Since vigour and creativity had the highest within-person correlation ($r = .57$, $p < .001$) and the strongest non-standardized path coefficient in the final model, we tested a measurement model where the cognitive liveliness and creativity items loaded on one underlying factor. We essentially modified M1 so vigour would be indicated only by the physical strength items, self-nudging, and prosocial behaviour by their respective items, but cognitive liveliness and creativity were merged into one underlying factor. The final measurement model (M4) specified the proposed 6-factor structure simultaneously at both levels of analysis. This model was constructed to gauge whether the daily measures are best represented only at the within-person level or also at the between-person level.

After establishing the fit of the measurement model, we constructed the hypothesized structural model (M5; Figure 1). We controlled for the lagged autoregressive effects of previous days' measurements on all variables, the effects of previous days' self-nudging on next days' mediator and outcomes, as well as previous days' vigour on next days' outcomes. We compared this model to one structural alternative (M6), in which we inversed M5 and modelled the relationships in a reversed order (creativity and prosocial behaviour predicting self-nudging through vigour) to check for the possibility of reversed causation.

Indirect effects were calculated in Mplus, using symmetric 95% confidence intervals (Muthén & Muthén, 1998–2017). Goodness-of-fit was evaluated using the comparative fit index (CFI), the Tucker–Lewis Index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Values of .95 or higher for CFI and TLI, and .05 or lower for RMSEA and SRMR indicate excellent fit of the model to the data, while values of .90 are the lowest for CFI and TLI and .06 for RMSEA and .08 for SRMR, the highest, indicate acceptable fit indices (Hu & Bentler, 1999).

Results

Descriptive statistics

Means, standard deviations, intraclass correlations (ICC), and within-person correlations among the study variables are presented in Table 1.

Measurement models

Fit indices of all models are summarized in Table 2. The MCFA indicated that the proposed measurement model (M1) showed acceptable fit to the data ($\chi^2[369] = 1512.02$, $p < .001$; CFI = .91; TLI = .90; RMSEA = .06, $SRMR_{Within} = .06$). The model that specified all items indicating one underlying method factor (M2) produced unacceptable fit indices ($\chi^2[377] = 7364.29$, $p < .001$; CFI

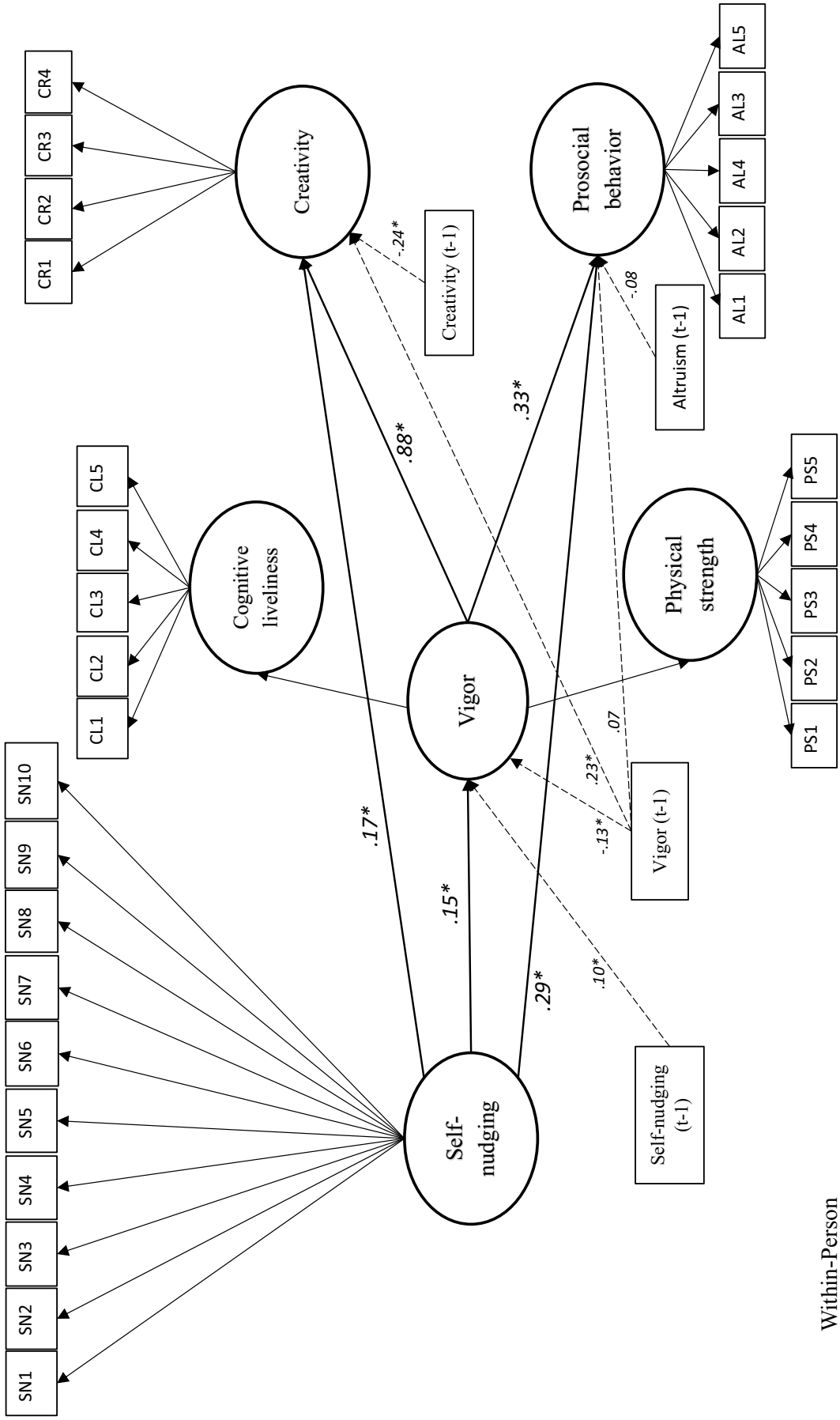

Figure 1. Multilevel SEM results. Note: All measures and effects are at the day-level (within-person). Path coefficients are unstandardized. SN1-SN10 – self-nudging items; CL1-CL5 – Cognitive liveliness items; PS1-PS5 – Physical strength items; CR1-CR4 – Creativity items; AL1-AL5 – Altruism items. Arrows with dashed lines mark lagged effects of the predictor and mediator and autoregressions on the daily states (e.g., vigour regressed on vigour *t*-1 is the effect of previous days' vigour on the next day).

Table 1. Descriptive statistics and within-person correlations between focal variables.

	M (SD)	ICC	1	2	3	4	5	6	7
1. Daily self-nudging	2.6 (1.41)	.75	–		.31**		.40**		.43**
2. Daily self-nudging (*t*-1)	2.6 (1.38)		−.15**	–					
3. Daily vigour	4.6 (1.18)	.46	.26***	.05			.68**		.35**
4. Daily vigour (*t*-1)	4.6 (1.17)		.01	.24***	−.14**	–			
5. Daily creativity	3.92 (1.41)	.49	.20***	−.03	.57***	−.02	–		.39**
6. Daily creativity (*t*-1)	3.9 (1.41)		−.02	.23***	−.09	.56***	−.17***	–	
7. Daily prosocial behaviour	3.83 (1.39)	.56	.19***	−.03	.27***	.02	.21***	.05	–
8. Daily prosocial behaviour (*t*-1)	3.87 (1.38)		.12**	.19***	.04	.20***	−.01	.18***	−.04

Note. $N_{L1} = 672$, $N_{L2} = 182$. ICC = Intraclass Correlation Coefficient. *t*-1 = lagged variable (previous days' self-nudging, vigour, creativity, and prosocial behaviour).
***$p < .001$; **$p < .01$; *$p < .05$.

Table 2. Model fit information.

Model	χ2	df	CFI	TLI	RMSEA	$SRMR_{within}$	$SRMR_{between}$	Δχ2	Δdf
Measurement models									
M1 – hypothesized 6-factor structure	1512.02***	369	.91	.90	.06	.06	.00		
M2 – single-factor structure	7364.29***	377	.44	.40	.15	.19	.00	5852.27***	8
M3 – cognitive liveliness – creativity overlap	2252.01***	371	.85	.83	.08	.07	.00	739.99***	2
M4 - hypothesized 6-factor structure on both levels	1904.12***	738	.91	.90	.04	.06	.13	392.1	369
Structural models									
M5 – Hypothesized model	1533.63***	479	.91	.90	.06	.06	.00		
M6 – Reversed causation model	1545.77***	480	.91	.90	.06	.06	.00	12.1***	1

Note. In calculating *Δχ2*, M2, M3 and M4 were compared to M1. M6 was compared to M5.
***$p < .001$; **$p < .01$; *$p < .05$.

= .44; TLI = .40; RMSEA = .15, $SRMR_{Within} = .19$). The same was true for M3, specifying a common underlying factor indicated by the cognitive liveliness and creativity items ($\chi^2[371] = 2252.01$, $p < .001$; CFI = .85; TLI = .83; RMSEA = .08, $SRMR_{Within} = .07$).

The hypothesized structural model (M5) yielded acceptable fit indices ($\chi^2[479] = 1533.63$**; CFI = .91; TLI = .90; RMSEA = .06, $SRMR_{Within} = .06$). The reversed causation model (M6) had almost identical, but significantly worse fit ($\chi^2[480] = 1545.77$**; CFI = .91; TLI = .90; RMSEA = .06, $SRMR_{Within} = .06$; $\Delta\chi^2 = 12.1$, $p < .001$, $\Delta df = 1$). We retained and further interpreted M5 based on the difference in model fit, the theoretical assumptions outlined in the arguments regarding the direction of effects, and a close inspection of path coefficients in M5. The reversed model indicated that there is no significant reversed effect of vigour on self-nudging ($b = -.14$, SE = .10, $p = .164$) or prosocial behaviour on vigour ($b = .09$, SE = .04, $p = .052$)

Hypothesis testing

The data provided general empirical support for the hypothesized model. Offering support to Hypothesis 1, self-nudging significantly and positively predicted vigour ($b = .15$, SE = .05, $p = .005$), meaning that on days when employees were more actively exposing themselves to cues to be physically active, they felt more cognitively and physically lively. Self-nudging also significantly predicted creativity ($b = .17$, SE = .04, $p < .001$), and prosocial behaviour ($b = .29$, SE = .06, $p < .001$). This shows that employees' efforts to create environmental cues to keep them physically active during the day are reflected in their creativity and a positive orientation towards co-workers. Further, employees' sense of vigour significantly and positively predicted creativity ($b = .88$, SE = .07, $p < .001$) and prosocial behaviour ($b = .33$, SE = .09, $p < .001$), indicating that the mental and physical energy constituting ones' sense of vigour provided the fuel for more creative ideas and prosocial behaviours during the day. Turning to indirect effects (Table 3), the data showed that vigour significantly mediated the effects of self-nudging on creativity ($b = .13$, SE = .05, $p = .004$, 95% CI [.04; .22]), as outlined in Hypothesis 2. Lastly, supporting Hypothesis 3, vigour also mediated the daily relationship between self-nudging and prosocial behaviour ($b = .05$, SE = .02, $p = .04$, 95% CI [.003; .09]).

Additional analyses

Although we expected that self-nudging would particularly have immediate effects on the *same* day, additional analyses revealed several *lagged* effects across days. These lagged effects were included for two specific reasons. First, to test potential autoregressive effects from one day to the next, which need to be controlled for a stronger test of the same-day associations (i.e., higher vigour resulting from past day's high energy and not

Table 3. Indirect effects of daily self-nudging on daily creativity and prosocial behaviour through vigour.

Outcome	b	SE	p	95% CI	
				Lower	Upper
Daily creativity	.13	.05	.004	.04	.22
Daily prosocial behaviour	.05	.02	.04	.003	.09

Note. Predictor: Self-nudging; Mediator: Vigour. Estimates are unstandardized. *CI* – 95% confidence intervals.

present-day's self-nudging). The autoregressive effects that we kept under control were all negative. Vigour was a negative predictor of next-day vigour ($b = -.13$, SE = .04, $p = .003$), and creativity was a negative predictor of next-day creativity ($b = -.24$, SE = .05, $p < .001$). Prosocial behaviour was unrelated to next-day prosocial behaviour ($b = -.08$, SE = .05, $p = .088$). The lagged predictors were centred around the person-mean to capture within-person effects (Ohly et al., 2010). Thus, these negative autoregressive effects indicate that when employees experienced higher levels of vigour and creativity than their personal average across the study, they tended to report lower levels of vigour and creativity on the next day.

Second, we included lagged effects to test for potential carry-over effects in our hypothesized relationships (i.e., self-nudging is not only contemporaneously related to vigour, but also has a connection to the next day's energy). Such effects go beyond the momentary associations and provide a stronger test for the hypothesized direction of effects. Regarding carry-over effects across days, we found that self-nudging had non-significant direct relationships with both creativity ($b = -.03$, SE = .05, $p = .51$), and prosocial behaviour ($b = -.01$, SE = .05, $p = .85$) during the following day. However, self-nudging positively predicted vigour on the following day ($b = .10$, SE = .05, $p = .049$). Furthermore, vigour had a significant positive effect on creativity on the following day ($b = .23$, SE = .05, $p < .001$) but not on prosocial behaviour ($b = .07$, SE = .05, $p = .132$). These results suggest that self-nudging positively influenced employees not only on the days they practiced it but also had residual benefits for their energy levels on subsequent days. Additionally, vigour – enhanced by self-nudging – boosted creativity and prosocial behaviour on the same day while also predicting increased creativity on the following day. These findings underscore the extended impact of self-nudging and highlight its potential for enhancing both daily and future vigour and creativity.

Discussion

Modern work life often entails high cognitive demands, leading to sedentary behaviour as employees spend most of their time in front of computers, reducing opportunities for physical activity. Since traditional interventions promoting physical activity in office environments have generally shown limited success (Chu et al., 2016), the present study explored daily self-nudging – an innovative personal approach where employees modify their choice architecture to make it easier to engage in physical activities. Results from our daily diary study indicate that self-nudging towards physical activity positively influenced vigour – enhancing physical strength and cognitive liveliness – which, in turn, fostered creativity and prosocial behaviour at work. In what follows, we discuss these findings' theoretical implications.

Theoretical contributions

The present study demonstrates that self-nudges can be dynamically adapted to align with daily goals and changing circumstances. Nudges such as sharing physical exercise updates on social media, setting alarms for stretching, or placing motivational notes can be tailored to specific objectives. For instance, repositioning a yoga mat in a prominent location serves as a timely prompt for post-work physical exercise. With an intraclass correlation coefficient of .75, the findings reveal that 75% of self-nudging variance is due to stable individual differences, while 25% reflects daily variability. This variability demonstrates that self-nudging is not only a consistent behaviour but also one that can be adjusted daily, allowing it to have a tangible and meaningful impact on physical activity and well-being every day.

The first contribution of the present study to the current understanding of self-nudging is providing empirical evidence of its effectiveness in promoting essential components of daily vigour among employees. Previous studies have shown that self-nudging can promote healthier food product choices (Michels et al., 2024), increase fruit intake in the home environment (van Rookhuijzen et al., 2023), and reduce excessive smartphone use (Grüning et al., 2023). Our study expands this literature by showing that self-nudging towards physical activity contributes to physical strength and cognitive liveliness at work (Shirom, 2010.

Employees who proactively modify their surroundings – like using visual health cues, setting up their

smartphone to track steps/activities, or sharing their physical activity with friends through social media – streamline their decision-making regarding physical activity. This optimization reduces the need for conscious effort, making the choice to be physically active more automatic and less reliant on personal willpower (Thaler & Sunstein, 2008; Volpp et al., 2008). Adjusting the environment simplifies the process of engaging in physical activity, leading to increased physical strength and cognitive liveliness. The spillover effect of self-nudging into the next day's vigour demonstrates its prolonged benefits, suggesting that efforts to create an environment for ourselves that promotes more physical activity contribute to more than a momentary boost in well-being.

Second, we examined the broader implications of self-nudging and increased vigour for two non-targeted outcomes at work. The data supported the integration of self-nudging with the dual pathway to creativity model (Nijstad et al., 2010) revealing a positive link between self-nudging and creativity, mediated by vigour. According to the model, creativity requires flexible thinking and persistence-two pathways supported by vigour. Specifically, cognitive liveliness fosters flexibility, while physical strength fosters persistence. Our findings align with established research on the cognitive benefits of physical activity, such as improved executive control, attention, and memory (Roig et al., 2013; Verburgh et al., 2014), which are crucial for cognitive flexibility.

Interestingly, vigour was also positively related to *next-day* creativity, which may reflect the role of energy reserves and cognitive recovery processes. High vigour enhances the brain's ability to recover and consolidate during sleep, strengthening cognitive pathways crucial for creative thinking. Research shows that sleep-dependent memory consolidation reinforces neural networks involved in problem-solving and innovation, enabling ideas and cognitive patterns to solidify overnight (Diekelmann & Born, 2010). Additionally, evening relaxation and lower stress levels associated with high vigour can contribute to high-quality sleep (Sonnentag et al., 2022), enabling vitality and cognitive flexibility upon waking (Walker, 2009). This carryover effect might occur because sleep helps refresh attentional resources and executive function, which are essential for problem-solving and flexible thinking. This could mean that vigour not only enhances same-day creativity but also establishes a physiological and cognitive foundation for creative engagement the following day.

As a third contribution, we discovered that prosocial behaviour is an unintended positive outcome of self-nudging. Increased physical energy from self-nudging for physical activity seemingly made employees more willing to engage in helping behaviours, while enhanced cognitive liveliness may have fostered empathy and perspective-taking. The results suggest that self-nudging generates the energy and capacity needed to be prosocial. Our findings are consistent with previous studies showing that exercise enhances personal and social competencies (Gil-Beltrán et al., 2020; Lubans et al., 2016). Such improvements help individuals better understand and connect with others, which in turn encourages prosocial actions (Davis, 2015; Eisenberg et al., 2002). Our focus on non-targeted outcomes aligns with calls for research on unintended consequences (Beshears & Kosowsky, 2020). While some argue that unintended outcomes may reduce the impact of nudges, we found that self-nudging can produce unexpected positive effects at work.

Interestingly, we also found *direct* relationships between self-nudging towards physical activity and (a) creativity and (b) prosocial behaviour. The direct effects on these non-targeted outcomes could stem from unmeasured activated positive emotions (e.g., elated, excited, delighted) and concrete physical activity. Meta-analyses have shown that physical activity predicts positive emotions (Li et al., 2022; Wiese et al., 2018). According to Fredrickson (2001), positive affect enables individuals to broaden their range of thoughts and actions, making them more open to creative and flexible thinking. This broadening effect makes people more likely to explore alternative solutions and engage in innovative approaches when they experience excitement and interest while working. People who experience positive emotions are more likely to think outside the box, fostering adaptability and creative problem-solving (Amabile et al., 2005). Exploring whether positive emotions mediate the link between self-nudging and its outcomes is an exciting and relevant direction for future research in this literature.

The unpredicted direct effect of vigour on prosocial behaviour aligns with findings from Spanouli and Hofmans' (2021) diary study. They propose that employees with high energy are more likely to invest this vigour into prosocial actions, aiming to build positive outcomes like better performance evaluations, rewards, or future promotions. By channelling their energy into supportive behaviours, employees may be strategically enhancing their social capital and securing valuable resources. Spanouli and Hofmans observed that on high-vigour days, employees tended to engage in more organizational citizenship behaviours (e.g., offering encouragement and showing respect) while reducing counterproductive behaviours (e.g., ignoring colleagues or refusing assistance). The present study expands these

findings by showing that employees can use self-nudging to increase their own vigour and prosocial behaviours.

A final observation: in traditional nudging, individuals are often unaware of the influences guiding their behaviours, with the nudge's effectiveness partly attributed to this unawareness (Bovens, 2009). However, self-nudging uniquely empowers individuals by making them fully conscious of both the intent and function of the nudges they employ. Our findings demonstrate that self-nudging can foster positive outcomes, such as enhanced well-being and favourable work behaviours, even when individuals are actively involved in creating and implementing these nudges. This perspective aligns with recent research by Bruns et al. (2018) and van Rookhuijzen et al. (2023), which suggests that transparency in the goals and methods of nudging does not lessen its impact. These insights imply that conscious, self-directed nudging could be a sustainable way to achieve ongoing behavioural changes.

Practical implications

Our findings on self-nudging suggest several valuable applications for workplace environments aiming to enhance employee well-being, creativity, and prosocial behaviour. While the observed effects are statistically significant, we acknowledge that the practical effect sizes are likely modest. However, even small behavioural adjustments – when sustained over time and diffused across teams – may meaningfully contribute to a more energized and socially connected work culture. First, organizations might consider implementing self-nudging training modules, guiding employees to create simple, personalized cues for physical activity (e.g., setting reminders for short walks, stretching, or desk exercises). These micro-interventions can help maintain physical strength and cognitive liveliness throughout the workday. Second, managers may support a culture in which daily movement and self-reflection are normalized, thereby facilitating recovery from cognitively demanding tasks (see, Sonnentag, 2018). Small shifts – such as framing break routines as part of creative workflows – may also reduce the recovery paradox often observed in sedentary job. Third, digital self-nudging tools (e.g., app-based reminders, personalized prompts) could be integrated into broader well-being initiatives. Yet, we emphasize that such tools should always be autonomy-enhancing, non-coercive, and context-sensitive, respecting individual differences in capacity and preference (Reijula & Hertwig, 2022). Future research should empirically test the scalability and ethical implications of self-nudging interventions in applied settings, helping determine what level of behavioural change is necessary for tangible organizational impact. In sum, while promising, self-nudging should be implemented thoughtfully and evaluated systematically. Its potential lies not in radical change, but in scalable, self-directed micro-shifts that collectively shape more energized, empathetic, and creative workplaces.

Limitations and directions for future research

The current findings provide foundational but preliminary support for the contention that self-nudging can boost vigour and enhance work-related outcomes. Although a diary study approach was used, with controls for previous-day levels of vigour, creativity, and prosocial behaviour, it is important to acknowledge that we did not use an intervention design and therefore reverse causality cannot be entirely dismissed. Future research should adopt a more robust experimental design to better establish causation. For example, participants could be trained in self-nudging techniques specifically aimed at promoting physical activity, with outcomes compared against a control group to assess the unique effects of a self-nudging intervention on both physical and work-related behaviours. This approach would allow for more definitive conclusions about the role of self-nudging in enhancing physical activity and its subsequent impact on vigour, creativity, and prosocial behaviour. Experimental designs could also explore the optimal types and frequencies of self-nudges to maximize both immediate and long-term benefits for workplace vitality and performance.

Second, using self-reported data can introduce biases, such as social desirability and recall bias (Adams et al., 2005), potentially leading participants to overestimate their engagement in self-nudging, vigour, creativity, and prosocial behaviours. To enhance the validity of these findings, future research could integrate objective measures. For instance, physiological indicators like heart rate variability could provide a reliable assessment of physical exertion, while tools such as accelerometers or GPS data can offer quantifiable metrics of physical activity (Jeran et al., 2016). These objective data points would help validate self-reported measures, providing a more comprehensive understanding of the impact of self-nudging on work-related outcomes. Combining self-reports with such measures could yield a richer, more accurate dataset, thereby strengthening the study's conclusions and addressing limitations inherent in self-report data.

Third, while we hypothesized that vigour would fully mediate the link between self-nudging and the outcomes, the data showed that vigour only partially

explains the effects of self-nudging. Future studies can further explore other mediating mechanisms, such as an actual increase in physical activity (e.g., steps, minutes engaged in sports, physical micro-breaks). Another potential mediating mechanism could be an increase in positive affect (Li et al., 2022), especially during highly stressful days (Maher et al., 2021). Still another possible mechanism could be represented by an increase in psychological capital (i.e., self-efficacy, hope; see Salvador-Ferrer et al., 2024). Lastly, it is possible that employees reported higher prosocial behaviour because self-nudging prompted them to spend more time in social activities, which in turn gave them the opportunities to be more altruistic.

Fourth, it is important to recognize that our study on self-nudging was limited to one specific behavioural domain. While we focused specifically on self-nudging for physical activity, the concept holds promise for other domains like healthy eating, stress reduction, and prosocial behaviours. For example, self-nudges can promote prosocial actions by encouraging individuals to set daily reminders to assist others or allocate time specifically for supporting colleagues. These domains of behaviour were neither within the scope of the current study, nor covered by our instrument. The adaptability of self-nudging techniques to more complex work-related behaviours beyond physical activity remains an open question. Future research could extend our approach to test the impact of self-nudging across these varied domains, exploring the potential for similar positive outcomes in diverse areas of personal and professional life.

Fifth, a key limitation is that we did not have sufficient statistical power to examine between-person differences in self-nudging, even though this construct showed substantial between-person variance in our data (ICC = .75). Although time-invariant factors cannot *explain* day-to-day fluctuations directly, they can shape them via cross-level moderation, altering the strength of within-person relations. For example, employees in autonomy-supportive climates may translate daily self-nudging more strongly into vigour gains. Future research should recruit larger Level-2 samples, include relevant person-level and context measures, and test random-slope models with cross-level interaction terms to clarify these moderating processes.

Finally, while self-nudging is designed to enhance autonomy and promote goal-directed behaviour, potential downsides warrant critical reflection. First, self-nudging assumes a level of meta-cognitive capacity and self-awareness that may not be equally distributed across individuals (Morin, 2006; Reijula & Hertwig, 2022). Without this capacity, individuals may design ineffective or even counterproductive nudges. Second, self-nudging may unintentionally shift the burden of behaviour change onto individuals, especially in environments lacking structural support. Without sufficient resources or autonomy, self-nudging can lead to frustration or self-blame when goals are unmet (Reijula & Hertwig, 2022). This aligns with concerns raised by Marteau et al. (2021), who argue that overemphasizing individual agency in behaviour change risks ignoring social and contextual inequalities. Third, over-reliance on internal self-regulation through self-nudging may obscure the need for systemic or organizational change, placing undue emphasis on individual agency at the expense of context (Bakker, 2017; Houdek, 2024). These limitations do not invalidate the utility of self-nudging, but underscore the importance of situational fit, supportive environments, and individual differences in implementation.

Conclusion

Through this study, we found that daily self-nudging can help employees feel more vigorous, enhancing both physical strength and cognitive liveliness. Our findings offer practical insights for seamlessly integrating physical activity into daily routines, ultimately fostering a healthier and more productive workplace. This study provides a compelling argument for organizations to support and promote these practices by underlining their benefits in terms of creativity and prosocial behaviour. Supporting self-nudging initiatives in the workplace could not only improve employee well-being but also elevate creativity and positive interactions, driving overall organizational success.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

The data that support the findings of this study are available from the second author upon reasonable request.

Generative artificial intelligence

In the preparation of this manuscript, we used OpenAI's ChatGPT (version GPT-4) to optimize language, ensuring clarity, precision, and conciseness in the text. The tool was employed solely for language refinement and did not contribute to the conceptual development, data analysis, or substantive content of the manuscript. Its use was limited to improving readability and coherence.

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